The background.

Most vegetable crops produced are susceptible to nematode injury, particular by root nematodes. Plant symptoms and yield reductions are often directly related to pre plant infestation levels in soil and to other environmental stresses imposed upon the plant during crop growth. As infestation level increase so then does the amount of damage and yield loss. In general, the mere presence of root-knot or sting nematodes suggests a potentially serious problem, particularly on sandy ground during the fall when soil temperatures favor high levels of nematode activity. At very high levels, typical of those which might occur under doubling cropping, plants may be killed.

The Root-knot nematode, *Meloidogyne incognita*, infects all cucurbits and many other plants. This nematode is widespread in Albania, but is usually found in sandy or sandy loamy soils. It is an obligate parasite that must complete its life cycle in a plant host, but eggs are persistent and can remain inactive in the absence of a host and/or fallow for months or years.

As *M. incognita* larvae enter the plant root, feed and mature, the surrounding cells of the plant root increase in size and divide causing swellings, often referred to as galls, on the roots. The flow of nutrient and water is restricted, and plants wilt quickly when water becomes limiting. If plants are infected when young, they are often severely stunted and chlorotic. Infected vines rarely die, but are generally not productive[1].

Increasing concern for environment has stimulated the research for environmentally sound disease control including nematode management under farm condition. Integrated pest management (IPM) for nematodes requires[2]:

a. determining whether pathogenic nematodes are present within the field;
b. determining whether nematode population densities are high enough to cause economic loss; and
c. selecting a profitable management option.

Generally speaking, IPM should be considered a "a sustainable approach to managing pests (insects and other arthropods, weeds, plant pathogens, nematodes, mammals) by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks"[3]

Demonstration set up and results.

The spread of root knot nematodes infected soils in Albania has become an issue of concern for high value greenhouse producers and watermelon growers. Managing nematodes is a

[1] Diseases of watermelon in Arizona. www.cals.arizona.edu

[2] J.W.Noling. Nematode management in cucurbits (cucumber, melon, squash). www.edis.ifas.ufl.edu

[3] B.Jacobsen. 2007. Integrated pest management for vegetable growers. Montana State University.

relatively new issue for commercial growers. The use of commercial nematocides is expensive and risky to health and safety of environment.

Soil solarization is a passive technique used for controlling soil pests while eliminating the use of toxic soil fumigants. Through several specific demonstrations, the goal of AAC was to test the efficiency of using thin plastics films soil coverings (in a process so called "solarization") as a mean for reduction of nematode populations in greenhouses and open field conditions.

For that purpose, four demonstration plots were settled, respectively in; Lushnje (Hysgjokaj and Kemishtaj) and Berat (Drenovice and Gorican). Good farmers were selected based on a share cost agreement. Each plot a 1000 sq.m greenhouse, labor and input costs were provided by farmers, while AAC has contributed with the cost of plastic films for each demonstration.

The expected outcomes of the proposed technology included;

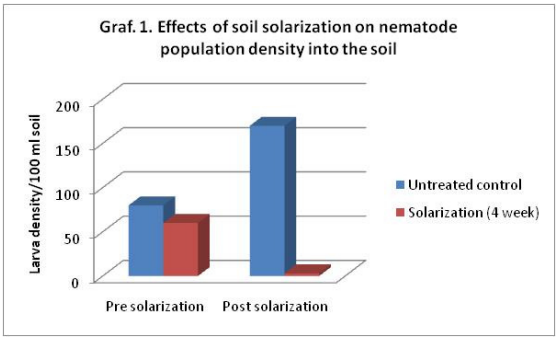
1. Increase in productivity.
2. Reduction of production cost by eliminating the cost of pest chemicals.
3. Return to a clean, healthy, and safe crop production environment.

The planned parameters to be measured included;

- temperature under plastic films at 10 and 20 cm depth,
- number of nematodes before and after solarization,
- marketable yield and the respective prices.

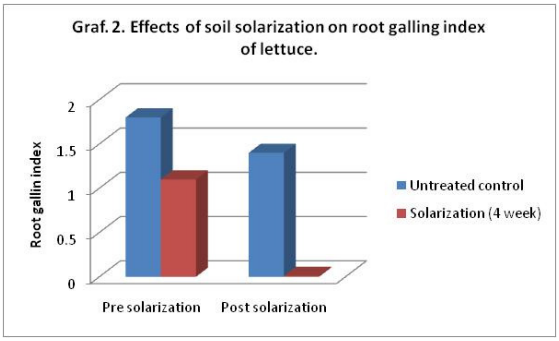
According to Jovani et.al, the best method used against Meloidogyne incognita is the soil solarization[4]. This method was used during years 1997 -2000, in sandy soil in Durres glasshouse. Due to solarization the maximum soil temperature achieved under solarization plots were 53,1 to 49,2°C respectively at depths 10 and 20 cm and 45 to 38 °C for uncovered plots. Because of high soil temperatures, nematode populations were significantly reduced from 49 to 93 %. All variants with soil solarization were significantly better than the control.

In similar experiments conducted in Lushnja and Durres regions the effectiveness of soil mulching by polyethylene during summer months against root knot nematode (*M.incognita*) has been tested during 2007. In closed plastic greenhouses the mulching of moistened soil with transparent polyethylene sheets during 4 weeks in July-August induce an increase of temperature, at 20 cm depth, of up to 49,6^{0}C in the alluvial soil in Rade-Durres and



[4] Vangjel Jovani. The effect of soil solarization to control of root-knot nematode Meloidogyne spp. in protected crops in Albania.

up to 52,4^{0}C in the heavy clay soil type in Kemishtaj-Lushnje. The same time, in the non solarized unheated greenhouse soil temperature achieved 37 to 39^{0}C[5]. The effect of soil solarization treatments on the population densities of *M.incognita* was very clear. The larva density per 100 ml of soil was markedly reduced compared with the untreated control (Graf 1)[6].

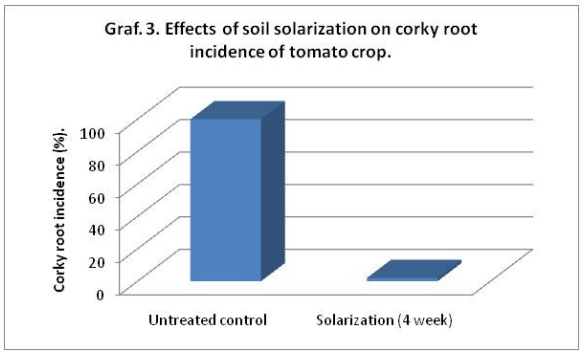


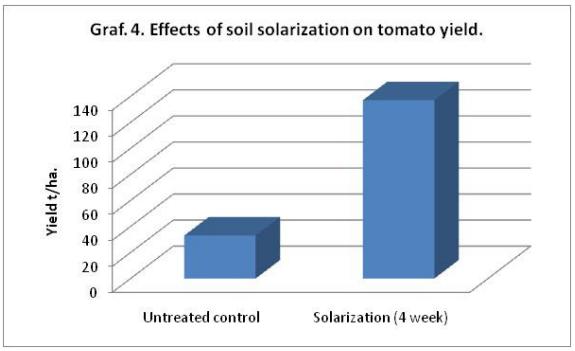
Root galling index is the most important symptom for the root knot nematode. In Lushnja region this index was dramatically reduced in solarized greenhouse compared with untreated control where the highest root galling index was found (Graf. 2). Soil solarization reduced nematode population 87 to 100% and root damages (galling index) were very low compared with untreated control[7].

The effectiveness of soil solarization was also tested for corky root (*Pyrenochaeta lycopersici* Schneider&Gerlach) management in a naturally infested plot of tomato in Lushnja region. The native fungal populations in covered moist soil were significantly reduced in comparison with uncovered treatment. At the end of harvest season the incidence of *P. lycopersici* was 2% and 100% respectively(Graf. 3)[8]. Tomato fruit yields in solarized greenhouses were more than 400% higher than those obtained in untreated control (Graf 4)[9].

Some demonstrations were organized to test the efficiency of a mixture of olive oil cake and poultry liter. Different amounts (from 10 to 50 ton/ha) were applied at plastic greenhouses, planted with cucumbers. Good results, in terms of nematode population reduction, were obtained by the use of a mixture of 10 ton/ha of each byproduct. One must be careful, because higher amounts, close to 50 ton/ha, have negatively affected plant performance and enhanced nematode population growth[10]. It means that specific components of these by products, in high concentration into the soil, becoming poison to plants. Consequently, weak plants are much more susceptible to soil pathogens and nematodes, namely.

[5] V. Jovani, J. Tedeschini, A.Ramadhi, D. Pfeiffer. Soil solarization a non chemical method to control root knot nematode and improve the yield of greenhouse crops. IPM CRSP/ Albania.
[6] V. Jovani, J. Tedeschini, A.Ramadhi, D. Pfeiffer. Soil solarization a non chemical method to control root knot nematode and improve the yield of greenhouse crops. IPM CRSP/ Albania.
[7] V. Jovani, J. Tedeschini, A.Ramadhi, D. Pfeiffer. Soil solarization a non chemical method to control root knot nematode and improve the yield of greenhouse crops. IPM CRSP/ Albania.
[8] H.Pace, J. Tedeschini, B. Stamo , D. Pfeiffer. Effects of soil solarization for controlling soil borne fungi in tomato plastic houses in Albania. IPM CRSP/ Albania.
[9] H.Pace, J. Tedeschini, B. Stamo , D. Pfeiffer. Effects of soil solarization for controlling soil borne fungi in tomato plastic houses in Albania. IPM CRSP/ Albania.
[10] Vangjel Jovani. Personal communication.





There are several chemical commercial products being used to control nematode infestations in agriculture. The most common ones in Albania are fenamifos (nemacur), etoprofos (etoprosip) and a recently introduced one is *bacilius firmus* (bionema). For each one, 100 to 200 l/kg are used for each hectare depending on nematode population density. The cost of application is in the range of 150000 to 400000 ALL/ha.

Discussion and recommendations.

Soil solarization offers a satisfactory and environmentally friendly solution for the control of root-knot nematode. This method is easily used into organic, conventional and integrated control growing system. Given the obvious benefits associated with soil solarization, government may consider promoting the practice

According to current government subsidy scheme being implemented, each farmers having more than 0.2 ha of common greenhouse is entitled to a grant of up to 300 000 ALL intended to buying plastic films. The soil solarization practice could be promoted by linking subsidy provided to farmers with introduction of soil solarization (soil solarization could be one of the eligibility criteria) as in case of organic production used in current scheme. Government may also consider increasing the subsidy to cover the plastic costs incurred in case of soil solarization.

Because of the nematodes wide host range, its control is difficult. Cotton, sorghum, corn, and beans, among many other crops, are all hosts and should not be rotated with watermelon when *M. incognita* is a problem. Rotations to alfalfa and oats, which are not hosts, are effective, especially in multiple year rotations[11]. There are reports that oil seed radish, also, suppressed M.incognita under field conditions[12].

[11] Diseases of watermelon in Arizona. www. cals.arizona.edu.

[12] A. Westphal, L. Xing & D. Egel. Use of cover crops for management of root knot nematodes in cucurbit crops. www. Purdue University.

Soil solarization could be combined with low rates of different nematocides, in order to enhance the positive effects of solarization. Similar results could be achieved by incorporating into the soil, prior to solarization, olive oil cake, poultry liter, or breakdown products of brassica crops.